Predicting the Physical and Chemical Properties of Elements

Introduction: Imagine that you are a chemist in 1869. The recent development of the periodic table by Russian chemist Dmitri Mendeleev has revolutionized the science of chemistry. More than 60 elements have been identified, and many of their physical and chemical properties have been determined.

Imagine that in your own laboratory, you have collected data for all but two of the first 20 elements. You still have to collect data for Lithium (the 3rd element) and for fluorine (the 9th element). You notice as you analyze your data that there are some patterns, so you decide to make a graph of your data. That way you can use these patterns to predict the properties of the two elements you haven't collected data for yet.

Objectives:

- **Make graphs** for some of the physical & chemical properties of the first 20 elements in the periodic table.
- **Observe patterns** in the properties of elements based on their positions in the periodic table.
- **Predict** the properties of the two elements.

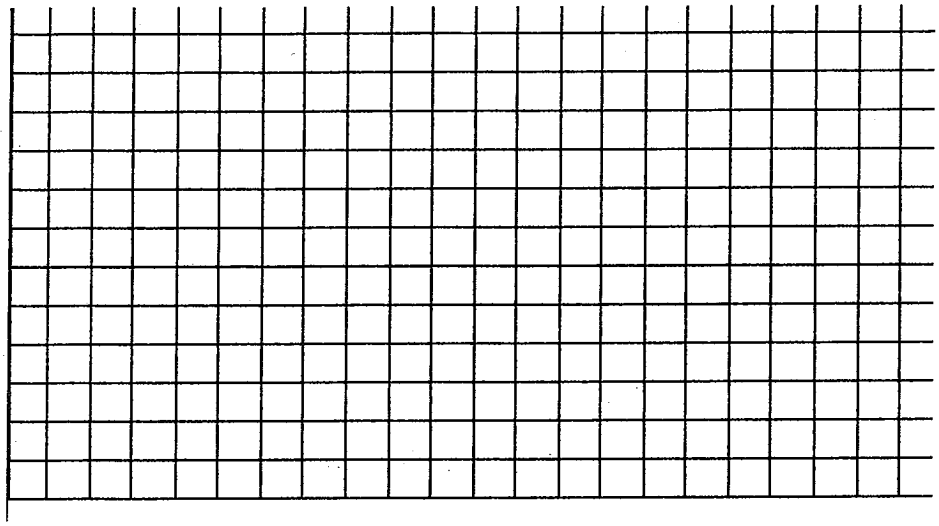
The Activity: When Mendeleev published the first periodic table of the elements in 1869, the response from chemists throughout Europe was very positive. Mendeleev saw that the properties of elements followed a pattern. In his periodic table, Mendeleev sometimes found it necessary to leave gaps so that elements with similar properties would line up in the same group, or column. As new elements were discovered, Mendeleev predicted their properties based on their prospective positions in the periodic table.

The patterns for the properties of the first 20 elements are not obvious when you first look at the data in the table. But if you plot the atomic number of the element on the x-axis and a property of the element on the y-axis, the pattern for that property become obvious. You can then use the graph to predict that property for lithium and fluorine.

Element	Atomic Number	Density (g/cm^3)	Melting Point (°C)	Boiling Point (°C)
H	1	0.088	-259	-253
He	2	0.21	-272	-269
Li				
Be	4	1.85	1283	2970
B	5	2.34	2300	2550
C	6	2.25	3570	4200
N	7	1.00	-210	-196
O	8	1.40	-218	-183
F				
Ne	10	1.40	-249	-246
Na	11	0.097	98	889
Mg	12	1.74	650	1120
Al	13	2.70	660	2327
Si	14	2.33	1414	2355
P	15	1.83	44	280
S	16	2.07	119	444
Cl	17	2.40	-101	-34
Ar	18	1.62	-189	-186
K	19	0.86	64	774
Ca	20	1.55	845	1420

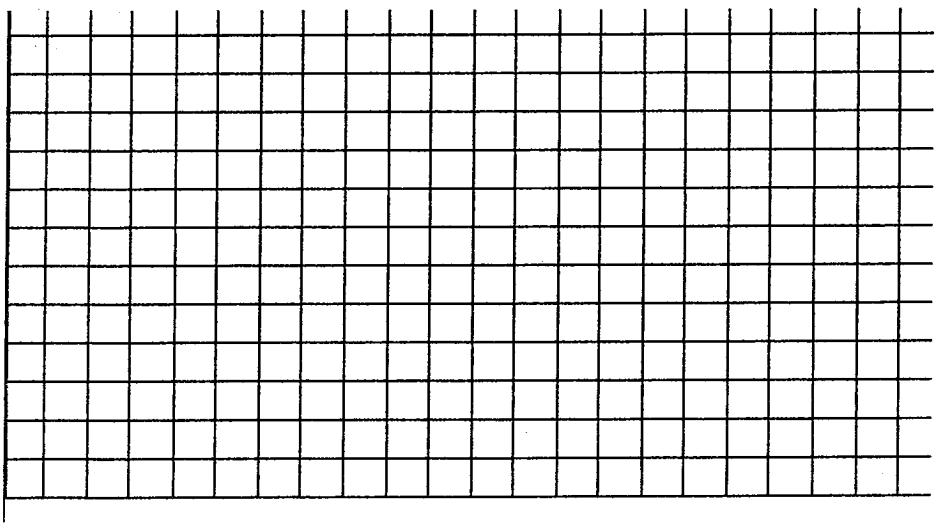
Graph the properties of the elements on the graphs provided below. Look at your periodic table and your graph to find the patterns.

Density of the First 20 Elements in the Periodic Table (use .25 per square on the y-axis)



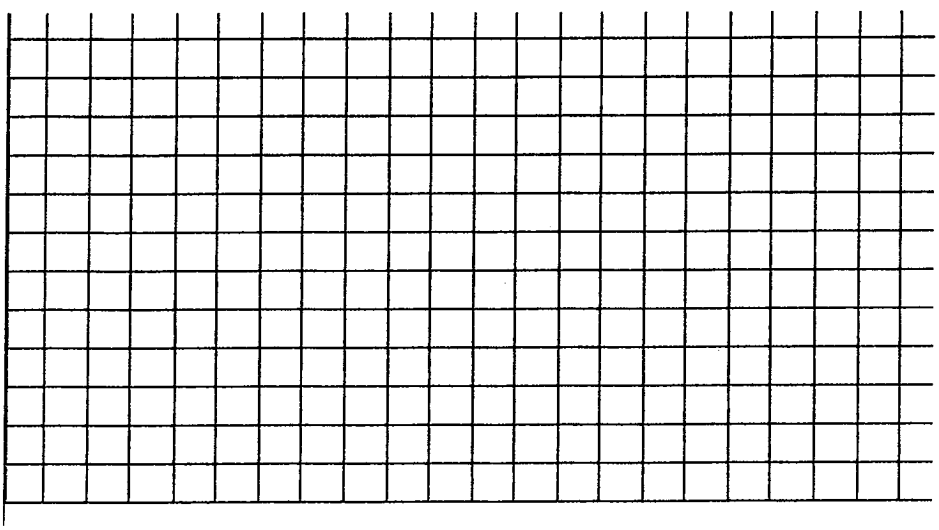
Describe the pattern in density.

Melting Point (start at -500 and go up by 400 per square on the y-axis)



Describe the pattern in melting point.

Boiling Point (start at -300 and go up by 400 per square on the y-axis)



Describe the pattern in boiling point.